Experiments on the Depolarization of Light as exhibited by various mineral, animal, and vegetable Bodies, with a Reference of the Phenomena to the general Principles of Polarization. By David Brewster, *LL.D. F.R.S. Edin. and F.S.A. Edin. In a Letter addressed to the Right Hon. Sir* Joseph Banks, *Bart. K.B. P.R.S.* Read December 15, 1814. [*Phil. Trans.* 1815, *p.* 29.]

When a ray of light has been so modified by reflection or refraction that in certain planes it is not divided into two parts by a prism of Iceland spar, that ray is said to be polarized; but it may again, by several means, be rendered divisible, and is then said to be depolarized. The object of the author, in this letter, is to comprise experiments on the depolarizing properties of a great variety of substances at the same time, and thence to deduce the general principles on which the various degrees or modes in which they exhibit this property depend.

Dr. Brewster has already, in a former communication, described the general phenomena of depolarization by mica, calcareous spar, topaz, and other regularly crystallized bodies, which have two neutral axes at right angles to each other, and two depolarizing axes also at right angles to each other, but making angles of 45° with each of the neutral axes.

Of the bodies now enumerated by the author, some have no polarizing or depolarizing properties, as rock salt, fluor spar, and spinelle ruby. Out of seven specimens of diamond, four did not depolarize; one depolarized about one fifth of the light, one about one half, and one nearly all the light in every position.

The next class of bodies subjected to experiment by the author, are vegetable and animal substances, from which he expects to deduce important conclusions.

Gum arabic depolarizes light in every position, unless in extremely thin chips. Cherry gum also depolarizes light, with some appearance of a neutral axis. Caoutchouc has the same property; and though it loses it when fused by heat, it recovers the same power gradually in the course of a few weeks. White wax, melted between two plates of glass, depolarizes in every position. Bees' wax has the same property, as may be exhibited by inclosing a portion of a cell of a honey-comb between layers of Canada balsam.

Manna, camphor, and balsam of Tolu were tried with the same results. Various fibrous vegetable substances have also the property of depolarizing, but have neutral axes in the direction of their fibres.

Adipocire from various sources, spermaceti, and soups of all sorts, depolarize in every position. Various kinds of hair, wool, feather, and silk depolarize, but have neutral axes in the direction of their length, and at right angles to it.

Human cuticle, human nail, and various kinds of horn; the cornea of the eye of a man, cow, or fish; a piece of bladder, isinglass, or glue, depolarize in all positions. Certain other animal substances, which are distinctly fibrous in one direction, exhibit neutral axes in

that direction, and at right angles to it, though they depolarize in other directions.

Acetate of lead, confusedly crystallized between two plates of glass, depolarizes in all positions. Plates of ice have in general the same effect, though some exhibit neutral axes.

Oil of mace being a soft solid, opake from confused crystallization, depolarizes also in all positions; but it also exhibits, through a very thin margin, a peculiarity not observed in any of the preceding experiments. When the flame of a candle is viewed through it, the flame appears surrounded by a halo; but if the light be polarized before it is transmitted through the oil of mace, then the flame has four wings or luminous radiations, at right angles to each other; and accordingly if two pencils of light be received at the same time by transmission through Iceland spar, then there are two such images, with their four wings transversely situated, so that the rays of one image correspond in position with the blank spaces of the other.

A slice of tortoiseshell, which also depolarizes in every position, exhibits also, by the polarized light of a candle, faint luminous rays, similar to those seen by oil of mace.

The author next classes these bodies according to the various degrees in which they more or less perfectly depolarize, and more or less perfectly possess neutral axes, in which depolarization does not take place.

The simplest case of depolarization is that effected by a thin plate of Iceland spar, or other regularly crystallized body, the principal section of which is not in the plane of polarization, or at right angles to it, and consequently occasions the polarized ray to be subdivided into two others transversely polarized, according to the original observation of Huygens. Hence if other bodies, as hair, wool, silk, &c. have neutral axes or planes, in which a transmitted ray retains its polarization, while it is depolarized in other positions, this affords optical evidence of the regularity of their internal texture; and though they cannot be called doubly refracting crystals, yet the author conceives that they form two images, which are coincident, but differently polarized, and accordingly that these bodies should be called doubly polarizing crystals.

Other bodies, on the contrary, like the confusedly crystallized acetate of lead, having axes in all directions, present no neutral axes, but depolarize in every direction; while others, according to the degree of their crystalline texture, have the property of depolarizing a greater or less proportion of the incident light, or, according to the degree of regularity of that texture, may exhibit some appearance of neutral axes.

With regard to oil of mace, Dr. Brewster observes, that since the continuous halo which surrounds the flame of a candle seen through it, is divided, by refraction through a prism of Iceland spar, into two sets of luminous radiations surrounding the two flames seen through it, having the luminous rays of the one corresponding in position to the vacant spaces of the other, he infers that the halo itself, in fact,

consists of eight luminous octants alternately polarized in a different manner; and observes, that if we knew in what way the halo is formed, there would probably be no difficulty in explaining these remarkable phenomena.

On an ebbing and flowing Stream discovered by boring in the Harbour of Bridlington. By John Storer, *M.D. Communicated by the Right Hon. Sir* Joseph Banks, *Bart. K.B. P.R.S.* Read January 19, 1815. [*Phil. Trans.* 1815, *p.* 54.]

In the year 1811, with a view to making certain improvements in the port of Bridlington, an examination was made of the depth of a stratum of clay, and another of gravel, at some distance below high-water mark. At low water the harbour is dry, and at high water it has from fifteen to seventeen feet of water in the deepest part. The spot fixed upon for boring, has about six feet of water in ordinary tides.

After boring through 28 feet of clay, and subsequently through a mixed stratum of chalk and gravel, the augur was found to strike against a solid rock, on which that instrument could make no impression, and the work was discontinued, without any appearance of water at that time rising in the bore. But in the course of an hour or two it was observed to be filled to the top with very limpid fresh water, which, after a short time, was projected some inches above the summit, in a stream equal to its calibre. As the water was found to be fit for washing, and all culinary purposes, the bore was first secured by an elm stock ten feet long, and perforated with a three-inch augur, through which was passed a copper tube of the same diameter, well tinned to the depth of 32 feet, and which thus reached from the bottom of the elm stock to the solid rock, in order to preserve a supply of water for the use of the town.

The stream, however, is found not to be constant, but to cease regularly when the tide has fallen to a certain distance, and not to flow again till the tide returns to the same level, its force increasing regularly as the tide advances; and it may be observed to be propelled with much force, even after the bore is overflowed by the tide. By attention to the height of the tide at the time that the water begins to flow, it is found to be very regularly 49 or 50 inches below the level of the top of the bore, excepting after any very unusual fall of rain, when the water has been known to flow even when the tide has fallen as much as eight feet below the top of the bore.

These appearances, says the author, seem not to admit of any satisfactory explanation, without supposing some subterraneous communication between the water of the sea and that of the spring; and Mr. Milne, under whose direction the work has been conducted, conceives the stratum of clay, through which the water issues, to extend over the whole bay in front of the harbour, as far as to Smithwick Sand, which is known to be supported by a ledge of rock that has an almost perpendicular face, and very deep water beyond it. It is